Sustaining Deep Draft Navigation at the Mouth of the Columbia River, Oregon and Washington

Coastal Infrastructure in the Pacific Northwest

In 1802, Thomas Jefferson instructed Congress to "look forward to distant times". After 18 months of travel from St. Louis, Missouri, the Corps of Discovery entered the Columbia River estuary on 7 November 1805. William Clark declared "Ocian in view! O! the joy". So began the tide of "Manifest Destiny", which brought many changes to the Pacific Northwest.

In the days of sailing ships, traversing the Columbia River bar was treacherous business. The bar is where the flow of the river rushes headlong into towering ocean waves. The natural channels over the bar often shifted widely within the course of several tidal cycles and ships sometimes had to wait weeks before conditions were favorable for bar crossing. With the "opening of the west" that was occurring in America during 1860-1880, a consistent and reliable navigation channel was needed through the MCR to link inland areas of the Pacific Northwest with other parts of the country and world. On 5 July 1884, Congress authorized the U.S. Army Corps of Engineers to implement what would be the first of a series of many improvements to secure a stable navigation channel through the Mouth of the Columbia River (MCR).

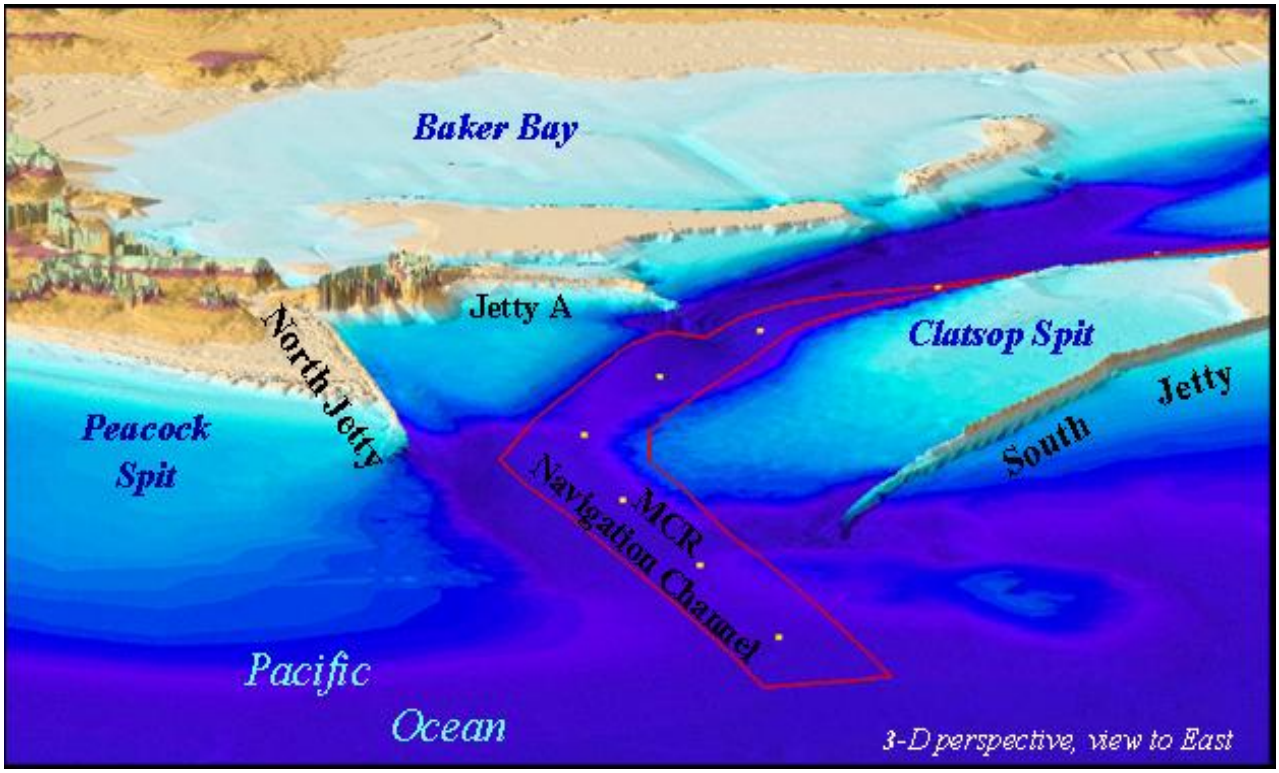
The central project feature at MCR is the navigation channel. The north and south jetties are the two most important features that act to maintain the stability of the navigation channel. The MCR jetties were constructed on massive tidal sand shoals during 1885-1939. The overall length of the rubble mound north and south jetties is 2.35 miles and 6.62 miles, respectively. Originally, each project feature was constructed as a separate entity to fulfill a specific hydraulic function, while minimizing the overall maintenance needed to provide safe navigation through the MCR. All the project features were justified based on the need to secure the MCR deep draft navigation channel. Through phased jetty construction and the associated response of MCR morphology, each project feature at MCR is now dependent on the other; both in terms of structural integrity and project feature functional performance. The rubble mound jetties have experienced significant deterioration since construction, due to foundation instability associated with the erosion of tidal shoals on which the jetties were built, and increased wave and tidal action affecting each structure. Our challenge is to maintain the MCR entrance in context of aging infrastructure, sediment management opportunities, and restrictive budgetary capability.

The present authorized deep-draft navigation project at MCR provides for a 2640-ft wide channel across the Columbia River bar. The northerly 2,000 ft of the channel is maintained at -55 ft MLLW (plus 5 ft for over dredging), and the southerly 640 ft of the channel is maintained at –48 ft MLLW (plus 5 ft for over dredging). The 5-mile long deep-draft navigation channel at the mouth of the Columbia River (MCR) has become the ocean gateway for navigation access to/from the 500-mile long Columbia – Snake River system. The Columbia - Snake River navigation systems provides for efficient movement of commerce from the western slopes of the Rockies to the Pacific Ocean. Each year, ocean-going vessels on the Columbia River transport some $14 billion worth of U.S. products to world markets and 48 million tons of cargo passes through MCR annually. The lower Columbia River comprises the world's second largest grain export system, next to the Mississippi River. More than 40 % of the United States' wheat exports are shipped via ports on the Columbia and Willamette rivers. More than 12,000 commercial vessels and 100,000 recreational/charter vessels navigate through the MCR annually.

This presentation will highlight the historical changes that have occurred at the MCR in response to navigation improvements. Specific topics covered will include jetty construction and morphological response of the inlet, hydraulic forcing, effects of dam construction, dredging, dredged material disposal, past jetty repair, and challenges for future sustainability of navigation through the MCR Relevant subject matter will touch on present jetty repair activities and the regional sediment demonstration project at MCR.

Interesting MCR Statistics:

12 million tons of stone has been used to build and maintain the MCR jetties, $1 billion (1885-1982).
190 million cy of sand has been dredged from the MCR channel (1904-present).
>600 million cy of sediment was discharged to the ocean in response to MCR jetty construction.
Present annual average MCR channel dredging is 3.5 million cubic yards (sand)
Tides at MCR occur twice daily (semi-diurnal) with a mean range of the higher tides = 7. 5 ft
Present Columbia River (daily averaged) flow can range between 100-500 thousand ft^3/sec.
Peak flow of estuarine water through the MCR during ebb tide can exceed 1.8 million ft^3/sec.
Currents within the MCR can exceed 9 ft/sec.
Waves offshore MCR can exceed 30 ft high during winter. 50-ft waves have been observed.
2,000 vessels have been wrecked at MCR over the past 300 years; 700 lives have been lost.



TOP graphic is the ocean entrance to the Mouth of the Columbia River, view west to east. Distance between north-south jetties is about 2 miles. BOTTOM graphic is a 3-D perspective view of MCR. Land is shown as **tan/brown**, area below water are **blue hues**. **Pale blue** notes underwater shoals. **Dark blue** hues are deeper than 75 ft. The navigation channel is maintained at 60 ft depth by dredging.